

REMARKS

Claims 4-31, 34-37, 39-53, 55, 57-66 and 107-110 are now pending in this application. Claims 4, 19, 22, 25, 31, 35, 37, 42, 50, 53 and 58 are independent. By this Amendment, Applicants have canceled Claims 67-99, 108, 111 and 112, and amended Claims 4, 19, 22, 25, 31, 35 and 42.

Claims 4-11, 14-25, 27-53, 57-60, 63-66 and 109-112, stand rejected under 35 U.S.C. § 102(e) over U.S. Patent No. 6,331,994 (Ohmi, et al.). Applicants traverse this rejection.

Applicants again submit that the Ohmi, et al. patent does not teach the specific features recited in the present claims, and disagree with the Examiner's characterization of the Ohmi, et al. patent. In particular, the Office Action states that Figures 3A-C and 4A-D of the Ohmi, et al. patent show the use of an electromagnetic wave passage having a predetermined distance which is equal to or greater than the half-wavelength of an electromagnetic wave. Applicants submit that those figures show an insulating plate 41 having a thickness equal to half of an electromagnetic wave. However, the structures shown in those figures do not include any slots. While Figure 8 of that patent shows a waveguide having slots, Figure 8 does not show electromagnetic wave passages being formed between the slots and the laser tube. Thus, Applicants disagree with the characterization of what is shown and described in the Ohmi, et al. patent with respect to the electromagnetic wave passage.

In addition, the independent claims recite structural features of the slots of the waveguide, and specific arrangements thereof. Applicants submit that the Ohmi, et al. patent does not describe the specific structural arrangements of the slots of the present invention. For example, at page 14, the Office Action states that the Ohmi, et al. patent describes (at column 13, lines 30-35) that the *widths* of longitudinal end portions of each of the slots are made larger than the width of a central portion thereof. Applicants submit, however, that the Ohmi, et al. patent merely sets forth the *lengths* of the slots.

For these and other similar reasons, Applicants submit that the Ohmi, et al. patent does not describe or suggest features of the present invention. Further, Applicants have provided below additional remarks with respect to each pending independent claim, which distinguish the present invention from that which is described in the Ohmi, et al. patent.

Independent Claim 4

As recited in independent Claim 4, the laser oscillating apparatus according to Applicants' invention includes, in part, an electromagnetic wave passage for connecting the plurality of slots and the laser tube between the laser tube and the waveguide so that electromagnetic waves emitted from the plurality of slots are formed into substantially plane-wave shape. A predetermined distance is provided between the waveguide and the laser tube, with that distance being equal to or greater than the half-wavelength of an electromagnetic wave introduced from the waveguide, as generally shown in Figure 5 of

the present application. With such a configuration, uniform intensity distribution is introduced into the laser tube.

The Office Action cites Figures 6A, 6B, 8A, and 9A-C of the Ohmi, et al. patent as showing a passage connecting slots of a waveguide and a laser tube. Specifically, the Office Action states that Figures 6A and 6B show a distance from the slots to the laser tube. Applicants submit that none of these figures shows the electromagnetic wave passage of the present invention. In particular, Applicants submit that Figures 6A and 6B merely show the length of the waveguide and Figures 9A-C merely show the arrangement of slots.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the features of an electromagnetic wave passage for connecting the plurality of slots and the laser tube, which provides a predetermined distance between the waveguide and laser tube so that electromagnetic waves emitted from the plurality of slots are formed into substantially plane-wave shape, the predetermined distance being equal to or greater than the half-wavelength of the electromagnetic wave introduced from the waveguide, as recited in independent Claim 4.

Independent Claim 19

As recited in independent Claim 19, Applicants' laser oscillating apparatus is defined, in part, by the width of the longitudinal end portions of the slots being made larger than the width of a central portion thereof. This configuration provides enhancement

of longitudinal uniformity of an electromagnetic wave passing through a slot. An example of this feature is shown in Figures 15 and 16 of the present application.

The Ohmi, et al. patent merely shows rectangularly-shaped slots, as shown in Figures 6A, 6B, 8A, 11A, and 12A of that patent. Accordingly, the slots described in that patent do not have longitudinal end portions wider than central portions thereof.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the feature of the width of longitudinal end portions of each of the slots being made larger than the width of a central portion thereof, as recited in independent Claim 19.

Independent Claim 22

As recited in independent Claim 22, in the laser oscillating apparatus, the slots are formed apart from a central axis along a longitudinal direction of the waveguide, and each of the slots is curved such that the longitudinal end portions of the slot are closer to the central axis than a central portion of the slot. This feature also enhances the longitudinal uniformity of electromagnetic waves passing through a slot. An example of this feature is shown in Figure 20 of the present application.

As discussed above, the Ohmi, et al. patent merely teaches rectangularly-shaped slots.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the feature of each slot being curved such that longitudinal end portions of the slot are closer to a central axis than a central portion of the slot, as recited in independent Claim 22.

Independent Claim 25

As recited in independent Claim 25, the laser oscillating apparatus includes an air-gap of resonating electromagnetic waves to be radiated from the slot to increase radiation efficiency formed in the waveguide wall in which the slots are formed. With this configuration, reflective electromagnetic waves at the slots are reduced and electromagnetic waves are efficiently introduced into the laser tube.

The Office Action states that Figures 5, 6A, and 6B of the Ohmi, et al. patent show the features of independent Claim 25. However, Applicants submit that those figures do not even show a slot. Further, Applicants submit that an air-gap structure, an example of which is shown in Figures 24-26 of the present application, is not described in the Ohmi, et al. patent.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the feature of an air-gap of resonating electromagnetic waves to be radiated from the slot to increase radiation efficiency is formed in the waveguide wall in which the slots are formed, as recited in independent Claim 25.

Independent Claim 31

As recited in independent Claim 31, in the laser oscillating apparatus, each of the plurality of slots has a tapered shape on a cross section parallel to the direction of introduction of an electromagnetic wave, whose sectional shape narrows toward the laser tube. This allows for the efficient introduction of the electromagnetic wave into the laser tube. An example of this feature is shown in Figures 28A and 28B of the present application.

Figure 8B of the Ohmi, et al. patent shows a cross-sectional view of the slots described in that patent. Applicants submit that the cross-sectional view shows that those slots are not tapered.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the features of each of a plurality of slots having a tapered shape on a cross section parallel to the direction of introduction of an electromagnetic wave, whose sectional shape narrows toward the laser tube, as recited in independent Claim 31.

Independent Claim 35

As recited in independent Claim 35, in the laser oscillating apparatus, the widths of end portions in a longitudinal direction of each of the slots are made smaller than the width of a central portion thereof. An example of this feature is shown in Figure 23 of the present application.

As discussed above, the Ohmi, et al. patent merely teaches rectangularly-shaped slots.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the features of the widths of end portions in a longitudinal direction of each of the slots being made smaller than the width of a central portion thereof, as recited in independent Claim 35.

Independent Claim 37

As recited in independent Claim 37, an electromagnetic wave in the waveguide of the laser oscillating apparatus forms a standing wave and each of the slots is formed so as to make the center of a slot substantially coincident with a node of the standing wave. Again, this feature enhances the longitudinal uniformity of electromagnetic waves passing through the slot. An example of this feature is shown in Figures 29-31 of the present application.

The Office Action cites the Ohmi, et al. patent as describing these features of the invention at column 12, lines 1-6, and column 13, lines 30-35. Applicants submit that these portions of that patent describe the positional relationship between the waveguide and an insulating plate, but do not suggest the positional relationship between the phase of an electromagnetic wave in the waveguide and the slots.

Accordingly, Applicant submits that the Ohmi, et al. patent fails to disclose or suggest at least the features of an electromagnetic wave in the waveguide forming a standing wave and each of the slots being formed so as to make the center of the slot substantially coincident with a node of the standing wave, as recited in independent Claim 37.

Independent Claim 42

As recited in independent Claim 42, the laser oscillating apparatus includes a shielding structure provided in the laser tube for shielding each of the electromagnetic waves emitted from the slots in order to prevent plasma generated from the electromagnetic waves from diffusing. This provides a more uniform discharge. An example of this feature is shown in Figures 34-39 of the present application.

The Office Action cites column 14, lines 23-42, of the Ohmi, et al. patent as describing a shielding structure. That section discusses the features of Figures 13 and 14 of the patent, which figures do not show the slots. Consequently, Applicants submit that this portion of the patent does not suggest a shielding structure for shielding magnetic waves ejected from the slots.

Accordingly, Applicants submit the Ohmi, et al. patent fails to disclose or suggest at least the features of a shielding structure provided in the laser tube for shielding each of the electromagnetic waves emitted from the slots in order to prevent plasma generated by the electromagnetic waves from diffusing, as recited in independent Claim 42.

Independent Claim 50

As recited in independent Claim 50, Applicants' invention is defined, in part, in that the width in a short-side direction of each of the slots is made smaller than the thickness of a sheath serving as a passage of the electromagnetic waves extending from an opening of each of the slots in the short-side direction. This configuration reduces the

fluctuation of sheath thickness and makes uniform the plasma density. An example of this feature is shown in Figure 40 of the present application.

The Office Action cites column 2, lines 56-62, and column 12, lines 22-30, of the Ohmi, et al. patent as describing the features of Claim 50. Applicants submit that this section of that patent (as well as the patent as a whole) does not define the width of the slots arranged on the waveguide.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the features of the width in a short-side direction of each of the slots being made smaller than the thickness of a sheath serving as a passage of the electromagnetic waves extending from an opening of each of the slots in the short-side direction, as recited in independent Claim 50.

Independent Claim 53

As recited in independent Claim 53, in the laser oscillating apparatus, a plurality of slots are arranged in the short-side direction of the waveguide to form a row of slots, and a plurality of rows of slots are disposed in the long-side direction of the waveguide. With this configuration, the density of the plasma is made uniform, while keeping enhanced radiant efficiency. An example of this feature is shown in Figure 41 of the present application.

Applicants submit that the Ohmi, et al. patent does not describe arranging a plurality slots in parallel, in a width-wise direction.

Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least the features of a plurality of slots arranged in the short-side direction of the waveguide to form a row of slots, as recited in independent Claim 53.

Independent Claim 58

As recited in independent Claim 58, the laser oscillating apparatus has a pair of waveguides sandwiching a laser tube, with the waveguides being constructed such that intensity distribution of electromagnetic waves introduced therefrom are shifted from each other. With such a configuration, oscillation efficiency is enhanced. An example of this feature is shown in Figure 45 of the present application.

While the Ohmi, et al. patent describes sandwiching a laser tube with a pair of waveguides (see Figure 17), that patent does not describe shifting intensity distributions of the electromagnetic waves.


Accordingly, Applicants submit that the Ohmi, et al. patent fails to disclose or suggest at least a pair of waveguides sandwiching the laser tube and constructed such that the intensity distribution of electromagnetic waves introduced therefrom are shifted from each other, as recited in independent Claim 58.

For the foregoing reasons, Applicants submit that the independent Claims are allowable over the Ohmi, et al. patent and request withdrawal of the rejection under 35 U.S.C. § 102.

The remaining claims in the present application are dependent claims which depend from the independent claims, and thus are patentable over the documents of record for reasons noted above with respect to those independent claims. In addition, each recites features of the invention still further distinguishing it from the applied patents. Applicants request favorable and independent consideration thereof.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

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